(12) UK Patent Application (19) GB (11) 2 333 079 (13) A

(43) Date of A Publication 14.07.1999

(21) Application No 9800512.7

(22) Date of Filing 09.01.1998

(71) Applicant(s)
TRW Steering Systems Limited
(Incorporated in the United Kingdom)
Resolven, NEATH, South Glamorgan, SA11 4HN,
United Kingdom

(72) Inventor(s)
Andrew Dale Broughton
Alwyn Bailey

(74) Agent and/or Address for Service
Urquhart-Dykes & Lord
91 Wimpole Street, LONDON, W1M 8AH,
United Kingdom

(51) INT CL^6
B62D 3/12 , F16H 19/04

(52) UK CL (Edition Q)
B7H HFQ H853
F2Q Q7A3E

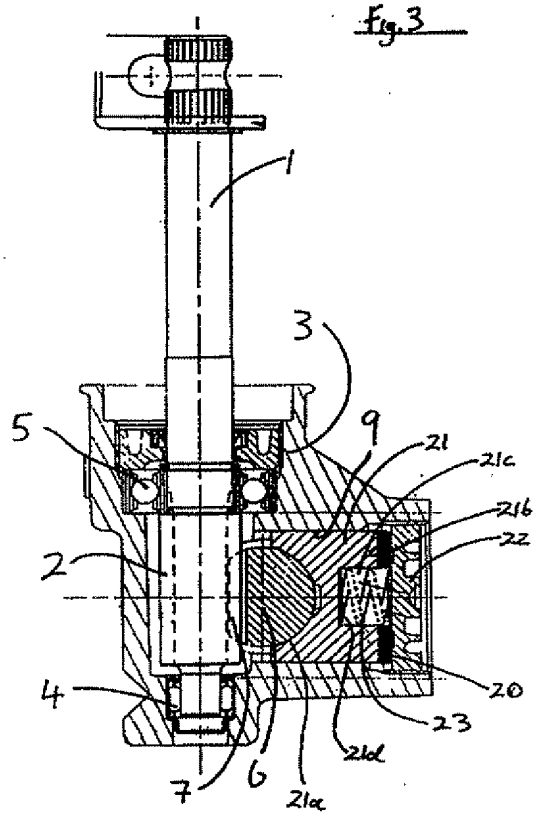
(56) Documents Cited
GB 1235458 A **GB 1181738 A** **GB 0945750 A**

(58) Field of Search
UK CL (Edition O) **B7H HFQ HHJ , F2Q**
INT CL^6 **B62D , F16H**

(54) Abstract Title
Rack and pinion assembly

(57) A rack and pinion assembly has a yoke 21 to hold the rack 7 in meshing contact with the pinion 2. The yoke 21 is urged against the rack 7 by a viscoelastic resilient means 20 supplemented by a compression spring 23. Cover 20 is screwed down in bore 9 to get a desired load to be exerted on the yoke 21. The viscoelastic means 20 prevents knocking by damping movement of the yoke in the bore 9 when the mechanism is operated.

Fig.3



GB 2 333 079 A

Fig. 1

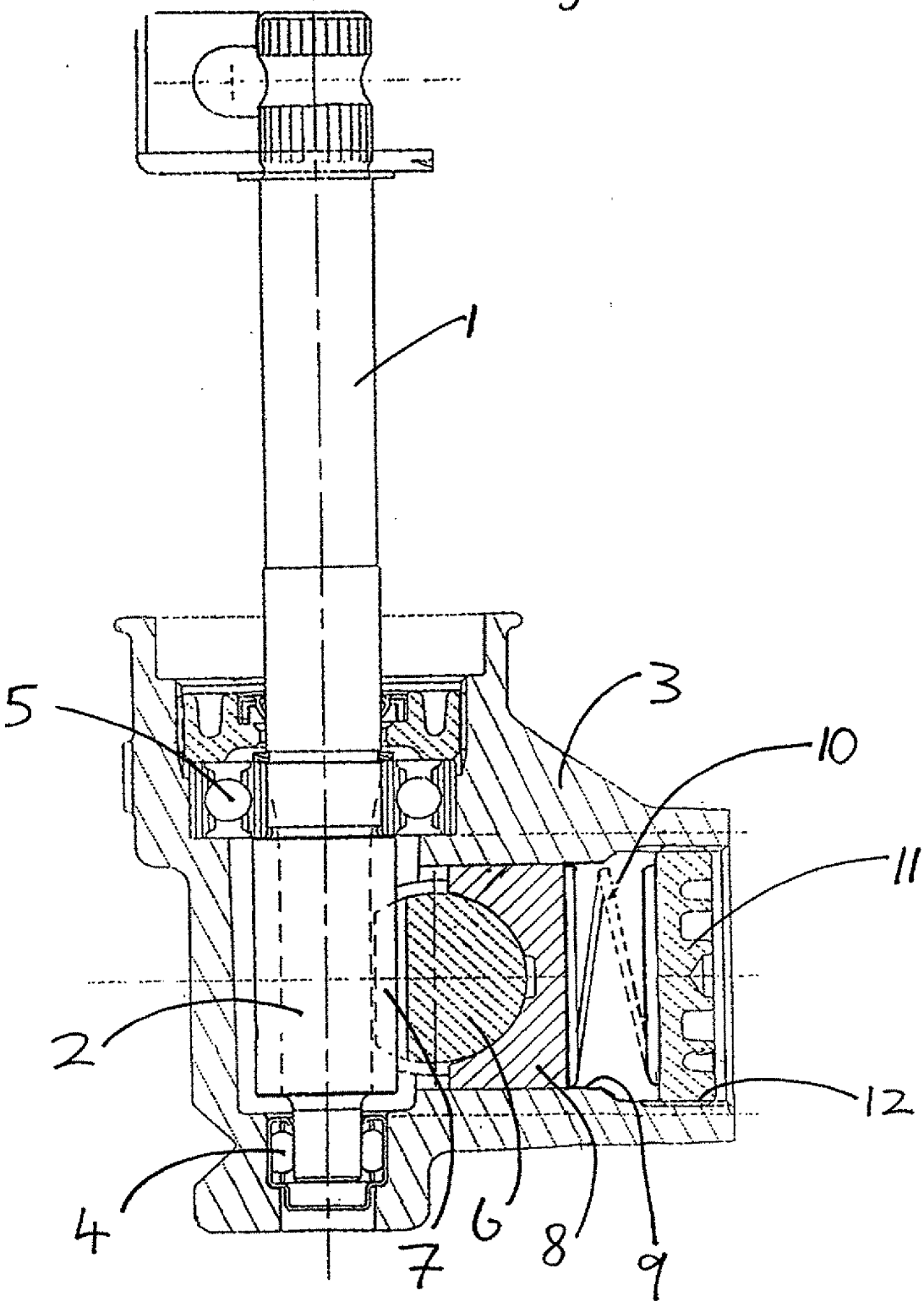


Fig 2

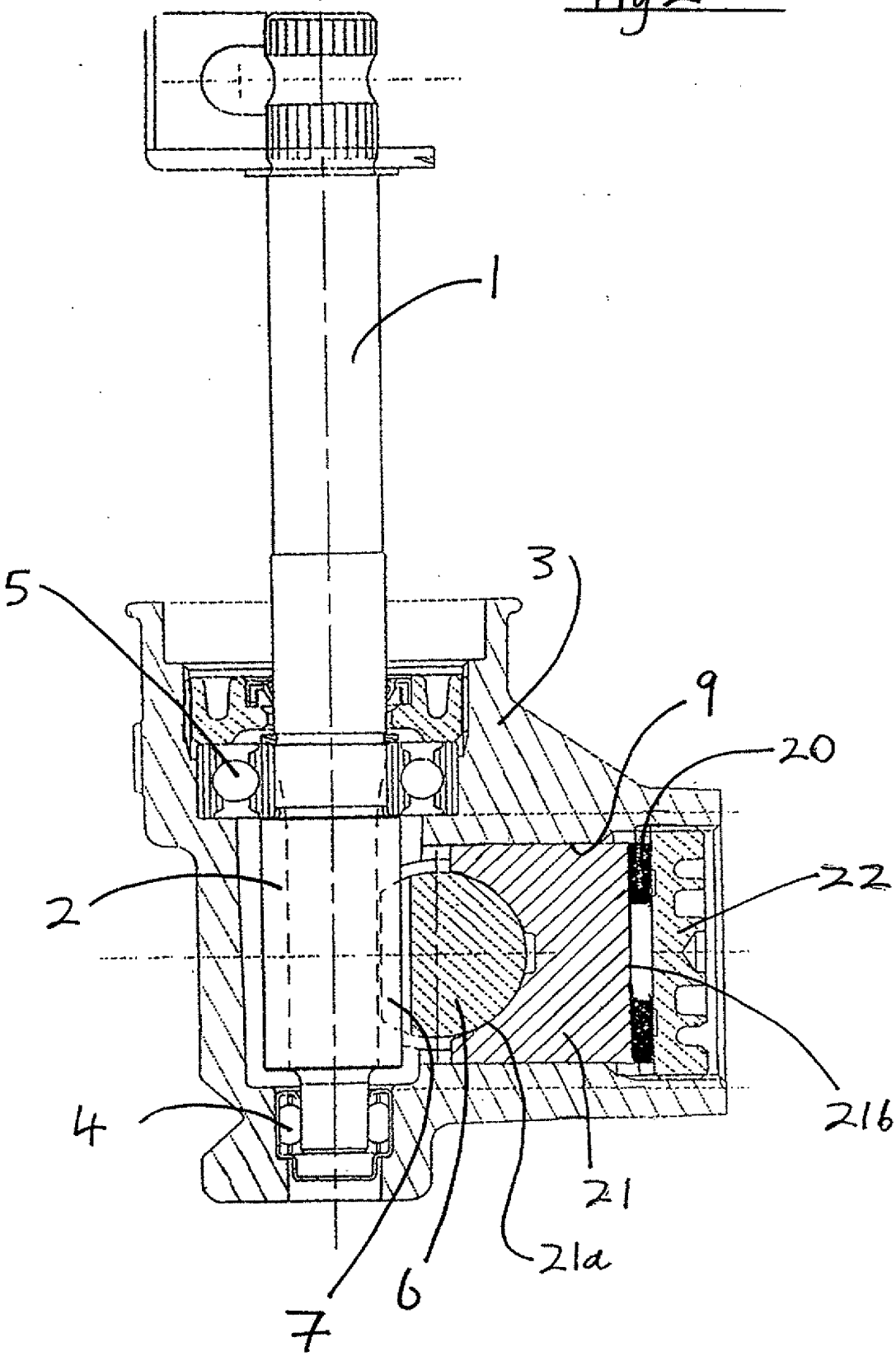


Fig. 3

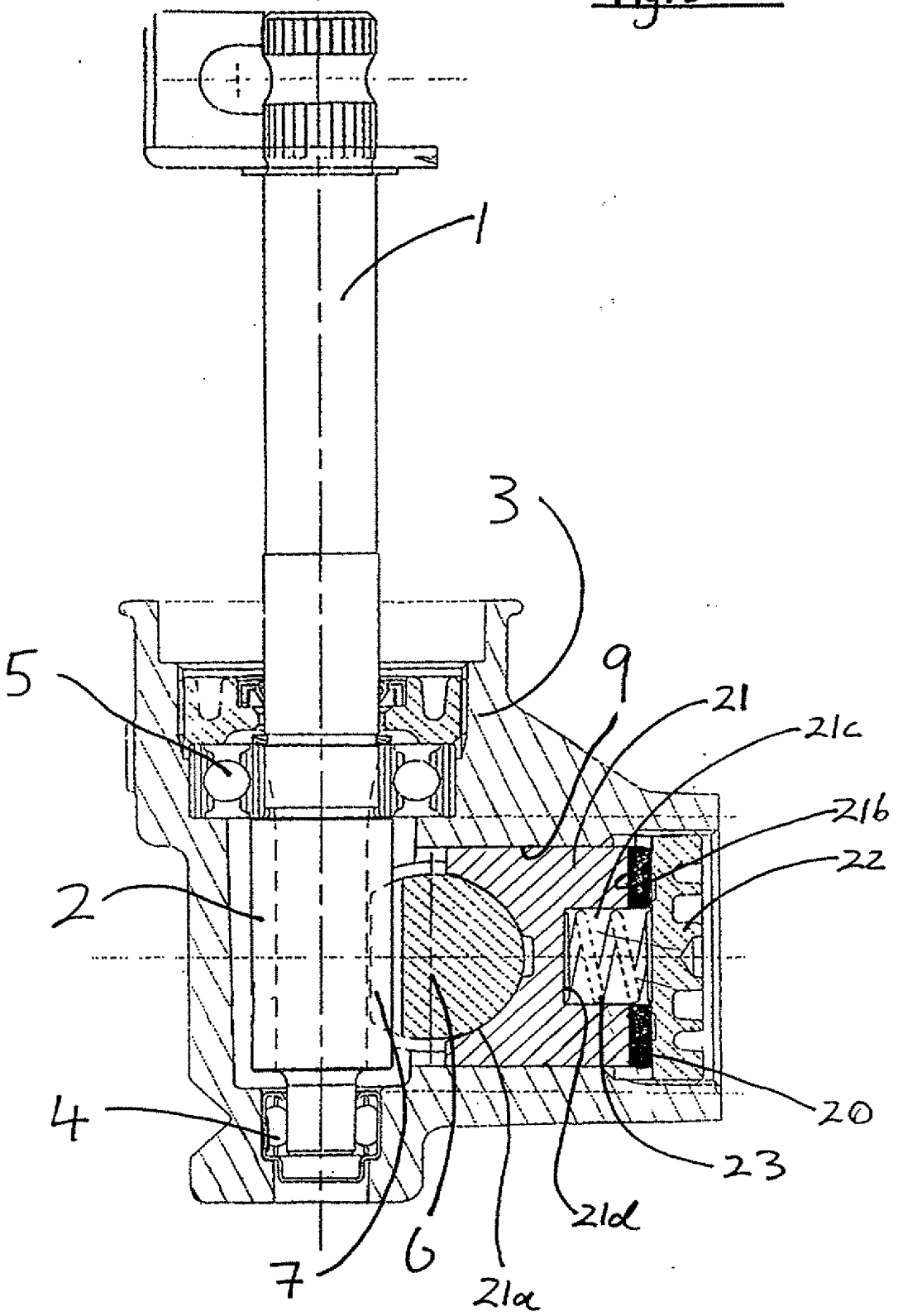
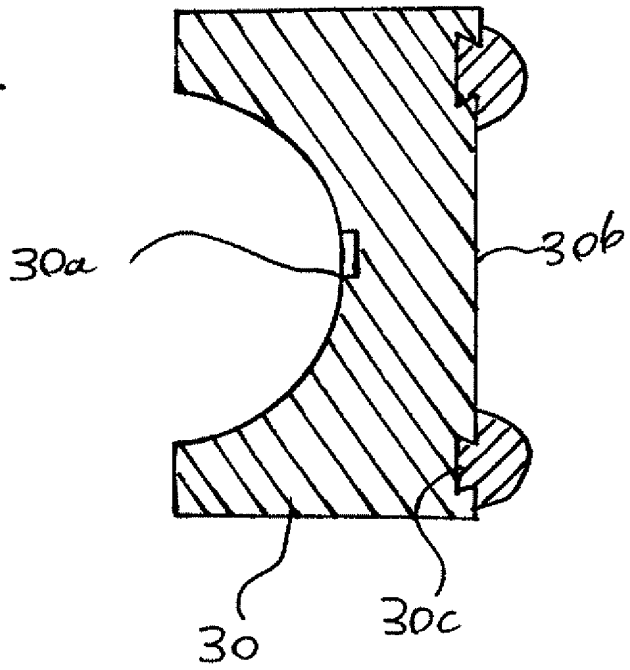


Fig 4



2333079

RACK AND PINION ASSEMBLY

This invention relates to a rack and pinion assembly and particularly to a rack and pinion assembly in which the rack is urged against the pinion by a resiliently moveable yoke.

A conventional rack and pinion vehicle steering assembly in which a rack is urged against a pinion by a resiliently moveable yoke is shown in figure 1. The steering assembly comprises a steering axle 1 bearing a toothed pinion 2 and connected to the vehicle steering column. The steering axle 1 is mounted for rotation in a steering housing 3 by bearings 4 and 5. Housing 3 also contains a rack member 6 having a toothed rack 7 engaging the pinion 2 and arranged for sliding movement relative to the housing 3.

The rack 7 of the rack member 6 is urged against the pinion 2 of the steering axle 1 by a yoke 8 so that the teeth of the rack 7 and the pinion 2 are maintained in meshing contact.

The yoke 8 is mounted for sliding movement along a bore 9 defined within the housing 3 and is urged along the bore 9 against the rack member 6 by a coil spring 10 which is compressed between the yoke 8 and a cover 11 which closes the end of the bore 9. The cover 11 is threaded around its outer rim for co-operation with a threaded section 12 of the interior of the bore 9. The degree of compression of the coil spring 10, and thus the loading of the yoke 8 against the rack member 6, is controlled by setting the distance to which the cover 11 is screwed into the bore 9.

A problem encountered in rack and pinion mechanisms of this type is that relative movement of the rack and pinion allowed by the resilient movement of the yoke can cause a knocking noise when the rack and pinion is operated. This is a particular problem in rack and

pinion vehicle steering assemblies because the knocking noise causes the user to believe that the steering mechanism is faulty, causing alarm and distress.

A second problem with conventional rack and pinion mechanisms of this type is that the separation between the yoke and the cover must be very accurately set in order to ensure that the correct amount of loading is applied to the yoke by the spring. The setting of a precise gap must be carried out by rotating the cover to a predetermined point along the threads within the bore. Such precise and reliable control of rotational position is inconvenient and difficult to ensure during manufacture and particularly following repair or maintenance of a rack and pinion vehicle steering mechanism.

This invention is intended to provide a rack and pinion mechanism which overcomes the above mentioned problems at least in part.

This invention provides a rack and pinion mechanism comprising a rack, a pinion, a viscoelastic resilient means and a yoke member between the viscoelastic resilient means and the rack.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying diagrammatic figures, in which:-

Figure 1 is a cross sectional view of a rack and pinion vehicle steering mechanism;

Figure 2 shows a first embodiment of a rack and pinion vehicle steering mechanism employing the invention;

Figure 3 shows a second embodiment of a rack and pinion vehicle steering mechanism employing the invention; and

Figure 4 shows a diametric cross sectional view through an alternative yoke design;

similar parts having the same reference numerals throughout.

Referring to figure 2, a first embodiment of a rack and pinion steering mechanism according to the

invention is shown comprising a steering axle 1 bearing a toothed pinion 2 and supported for rotation in a steering housing 3 by bearings 4 and 5. The steering mechanism shown is a manual steering mechanism. The invention is equally applicable to an assisted steering mechanism such as a hydraulically, pneumatically or electrically assisted steering mechanism.

A steering rack member 6 is mounted for sliding movement relative to the steering housing 3 and bears a toothed rack 7 to allow the rack member 6 to be driven in lateral sliding movement by the pinion 2 on rotation of the steering axle 1.

The steering rack member 6 is urged towards the steering axle 1 to maintain positive meshing contact between the teeth of the pinion 2 and the teeth of the rack 7 by a viscoelastic ring 20 acting through a yoke member 21.

The yoke member 21 has a front, bearing face 21a shaped to cooperate with the rack member 6 and is constrained to slide along a bore 9 in the steering housing 3. The viscoelastic ring 20 is held in a deformed state between the rear face 21b of the yoke 21 opposite to the bearing face 21a and the cover 22. The cover 22 bears screw threads around its circumferential edge. The screw threads cooperate with screw threads on the inner circumferential surface of a threaded section 10 of the bore 9 to allow the cover 22 to be screwed in and out of the bore 9 to alter the degree of deformation of the viscoelastic ring 20 and accordingly alter the force with which the yoke 21 urges the rack 7 against the pinion 2. The cover 22 prevents dirt and foreign bodies entering the assembly.

In order to set the desired load to be exerted on the yoke 21 by the viscoelastic ring 20, the cover 22 is screwed down in bore 9 until a pre-set torque is reached.

The use of a threaded cover 22 is not essential. Some other form of adjustable or retained cover could be used. Further, although it is convenient for the cover to apply a load to the yoke it would be possible to use a structure having a separate loading element and cover element.

A viscoelastic material is a material which is deformable and elastic but incompressible and able to absorb energy when deformed.

One example of a suitable viscoelastic material is natural rubber, which can have its damping properties adjusted by suitable processing and curing. Other examples of materials which are suitable viscoelastic materials which can be processed, blended or cured to change their damping properties include SBR, NBR, HNBR, EPM, EPDM, CM, CSM and silicone. However, this is not an exhaustive list.

It is believed that it is the energy absorbing quality of the viscoelastic ring that prevents knocking by damping movement of the yoke up and down the bore when the rack and pinion steering mechanism is operated.

A second embodiment of a rack and pinion vehicle steering mechanism according to the invention is illustrated in figure 3 in which a rack and pinion vehicle steering mechanism similar to that shown in figure 2 is illustrated.

In this alternative embodiment the viscoelastic ring 20 is supplemented by a compression spring 23, otherwise the rack and pinion steering mechanism is the same as that shown and described with reference to figure 2.

The compression spring 23 is compressed between the inside surface of the cover 22 and the bottom surface 21d of a recess 21c formed in the rear face 21b of the yoke 21.

Such an arrangement where the viscoelastic ring

bears against a surface of the yoke and the coil spring bears against the bottom of a recess in the surface is not essential but it is convenient in order to allow for the different characteristics of the compression spring and the viscoelastic ring.

The second embodiment can be used in systems where, in use, wear will cause the separation between the yoke 6 and the cover 22 to increase. If, due to such an increase, the separation becomes too great, the force exerted on the yoke by the viscoelastic ring can be reduced to too low a level to maintain the rack and pinion in cooperating contact. The coil spring 23 is arranged to have a much lower rate of reduction of exerted force with increasing separation between the yoke and the cover than the viscoelastic ring. Accordingly, the compression spring ensures that sufficient force is exerted on the rack member by the yoke to provide effective cooperating contact between the rack and pinion even after wear.

An alternative yoke design, suitable for use in the rack and pinion steering mechanism of the first embodiment, is shown in Figure 4.

The yoke 30 has a front, bearing face 30a shaped to cooperate with the rack member 6 and is shaped to be able to slide along the bore 9 similarly to the yoke 21.

The rear face 30b of the yoke 30 bears a circular recess 30c with overhanging edges.

A viscoelastic ring 31 is formed by moulding onto the rear face 30b of the yoke 30 overlying the recess 30c so that the viscoelastic ring fills the recess 30c, including the regions behind the overhanging edges.

This provides a viscoelastic ring 31 securely attached to the yoke 30.

A similar yoke design can be used in the rack and pinion steering mechanism of the second embodiment, provided that an additional recess to cooperate with the compression spring 23 is provided.

It is of course possible for the aperture to be non-circular, for multiple apertures to be used and for the viscoelastic ring 31 to be replaced by a viscoelastic member having some other shape.

The use of a yoke of circular cross section moving in a bore of circular cross section together with a circular viscoelastic ring and, where used, a compression spring acting along the centre line of the bore and yoke is not essential but is preferred. This arrangement is easily manufactured and assembled and avoids assembly and operational difficulties caused by asymmetric loading of the yoke against the pinion member and ensures that the viscoelastic element, and where used the compression spring, are not urged out of their desired positions by frictional forces when screwing down the cover 22. In particular, the viscoelastic ring could be replaced by a circular pad or a viscoelastic member having some other shape.

The above description is of examples only and it will be clear to a person skilled in the art that the invention can be applied to alternative arrangements.

Claims

1. A rack and pinion mechanism comprising a rack, a pinion, a viscoelastic resilient means and a yoke member between the viscoelastic resilient means and the rack.

2. A mechanism as claimed in claim 1 in which the rack and pinion are urged into contact by restoration forces of the viscoelastic resilient means acting on the rack through the yoke.

3. A mechanism as claimed in claim 1 or claim 2 in which the pinion is rotatably supported by a housing and the yoke and viscoelastic resilient means are contained in an aperture in the housing.

4. A mechanism as claimed in claim 3 in which the aperture and the yoke have a circular cross section.

5. A mechanism as claimed in claim 4 in which the viscoelastic resilient means is an annular circular element.

6. A mechanism as claimed in claim 4 or claim 5 in which the viscoelastic resilient means is held between the yoke and a cover.

7. A mechanism as claimed in Claim 6, in which the cover bears exterior threads which cooperate with an interior thread of the aperture.

8. A rack and pinion mechanism as claimed in any one of Claims 1 to 5, in which the viscoelastic resilient means is moulded onto the yoke.

9. A mechanism as claimed in any preceding claim in

which the rack and pinion are also urged into contact by restoration forces of a second resilient means.

10. A mechanism as claimed in claim 8 in which the second resilient means is a spring.

11. A vehicle steering mechanism including a rack and pinion mechanism as claimed in any preceding claim.

12. A rack and pinion mechanism substantially as shown in or as described with reference to Figure 2 of the accompanying drawings.

13. A rack and pinion mechanism substantially as shown in or as described with reference to Figure 3 of the accompanying drawings.

The Patent Office

9

Application No: GB 9800512.7
Claims searched: 1-13

Examiner: Vaughan Phillips
Date of search: 29 April 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B7H (HFQ, HHJ), F2Q

Int Cl (Ed.6): B62D, F16H

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1235458	(CAM GEARS) see p. 1 lines 72-88	1, 11 at least
X	GB 1181738	(CAM GEARS) see p. 2 line 130-p. 3 line 26	1, 11 at least
X	GB 0945750	(CAM GEARS) see p. 2 lines 11-29	1, 11 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.